PATENT SPECIFICATION 1,123,358

NO DRAWINGS.

1,123,358

Date of Application and filing Complete Specification: 10 Oct., 1966. No. 45208/66.

Application made in Germany (No. F47392 IVc/39b) on 9 Oct., 1965.

Complete Specification Published: 14 Aug., 1968.

Index at Acceptance:—C3 P(11A, 11C8B, 11C12B, 11C17, 11C20B, 11D5, 11K11); F2 A6A1.

Int. Cl.:—C 08 g 37/02.

COMPLETE SPECIFICATION.

Moulding Material Suitable for Making Sliding Elements.

We, FARBWERKE HOECHST AKTIENGESELLSCHAFT, Vormals Meister Lucius & Bruning, a Company recognized by German Law, of 6230 Frankfurt (M)-Hoechst, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to the manufacture of sliding elements, for example, bearing shells and bearing bushes and sliding guides made from a mixture of a polyacetal and a calcite and having an improved abrasion resistance.

The hitherto proposed bearings made from a polyacetal show good sliding properties, but they do not always meet the requirements made with regard to abrasion and service life. It has been proposed to improve the sliding properties of other thermoplastic materials by addition of molybdenum sulphide. Mixing molybdenum sulphide into a polyacetal, however, adversely affects the thermal stability of the material, thus rendering very difficult its perfect processing into shaped structures.

The present invention is based on the observation that sliding elements, for example, bearing shells, bearing bushes and sliding guides, having good sliding properties and an improved abrasion resistance can be manufactured from a mixture comprising a polyacetal having a melt index (i_2) at 190°C. within the range of 0.5 grams to 20 grams per 10 minutes, preferably 1 gram to 10 grams per 10 minutes and present in an amount within the range of 70 parts to 99.5 parts by weight, preferably 80 parts to 99 parts by weight, and a calcite, preferably chalk, in an amount within the range of 0.5 part to 30 parts by weight, preferably 1 part to 20 parts by weight. The good sliding properties of the polyacetal and the thermal stability are hardly affected by the incorporation of a calcite.

By the term "polyacetal" used herein there is meant a homopolymer of formaldehyde or trioxan or is a copolymer of trioxan, preferably containing units derived from a cyclic formal or a cyclic ether, for example, diethylene glycol formal, dioxolane, butanediol formal, ethylene oxide, oxacyclobutane or tetrahydrofuran in an amount of not more than 15% by weight. A copolymer of trioxan and ethylene oxide is particularly suitable.

One or more usual additives, for example, a stabilizer, a dyestuff, a pigment or a processing auxiliary may also be present in the mixture of the invention.

The efficiency of the calcite that is added to the polyacetal is, to a great extent, independent of its particle size, its origin (deposit) as well as of its working up or the process of its manufacture, as can be seen from the following table.

The polyacetal and the calcite can be mixed according to any known method. It is, however, preferably first to mix the two powders in a thorough manner in a mixer and then to process this mixture as such or in the form of granules. The sliding elements may be directly brought into the desired shape by injection moulding or structures shaped by press-moulding or extrusion may be further shaped by machining.

Sliding elements made from this mixture can be used in a wide range of applications without needing lubrication. They are therefore particularly appropriate for constructing plain bearings needing no attendance. As sliding partners are suitable a usual material, preferably, a metal, for example, a steel or a bronze.

In the following Example which illus-

trates the invention, the percentages are by weight unless otherwise stated.

EXAMPLE

A copolymer of trioxan and 2% of ethylene oxide units, having a melt index (i_2) at 190°C of 9.0 grams per 10 minutes and stabilized with 0.5% of 2,2'-methylidene-bis-(4-methyl-6-tert-butyl-phenol) and 0.1% of dicyano-diamide, was mixed at room temperature in a quickly rotating mixer with the amounts of different types of calcite specified in the table. Some samples of a calcite were coated with calcium stearate by treatment with stearic acid. The powder mixtures obtained were granulated with the help of an extruder. Subsequently, a solid profile was extruded and this profile was machined into test specimens.

For determining their abrasion resistance, the samples were pressed under a load of 150 grams against a steel shaft rotating at a circumferential speed of 2 metres per second and having a diameter of 65 millimetres. Before each test, the surface of the shaft was rubbed with an emery paper of granulation 400. Each test lasted for a period of 24 hours. The sliding surfaces were not lubricated (dry sliding wear).

The abrasion resistance is characterized by the volumetric wear amount ratio (according to German Industrial Standards 50 321). The volumetric wear amount ratio indicates the ratio between the amount of wear of the material to be tested and the amount of wear of the plastic material used as a comparative material in a determined case of wear. As the comparative material there was used the same acetal copolymer into which no filler had been incorporated.

The static friction measured under a pressure per unit of area of 10 kp/cm^2 on a polished, technically clean steel plate and the sliding friction measured at a sliding speed of 6.6 meters per second against a polished steel shaft under a pressure per unit of area within the range of 0 to 25 kp/cm^2 were the same with the polyacetal samples filled with the calcite as with those of the unfilled polyacetal within the tolerances.

For testing its thermal stability, the granulated mixture was kept at 230°C under a stream of oxygen and its loss in weight was determined after 30 minutes. The percentage of the loss in weight is also indicated in the table. The loss in weight of the mixtures was within about the same range as that of the unfilled material. In contradistinction thereto, mixtures containing within the range of only 0.5% to 2% of molybdenum disulphide had a loss in weight within the range of 5.3% to 14.6% within 30 minutes at 230°C. under an oxygen stream. Thus, the thermal stability of the polyacetal was notably impaired by even small additions of molybdenum disulphide.

TABLE

Type of chalk	*Weight proportion of chalk in the whole mixture*	*Wear amount ratio*	*Percentage of loss in weight at 230°C. in O_2 after 30 min.*
Amorphous Champagne chalk, particle size predominantly 1-3 μ, no particle above 8 μ and below 0.5 μ, coated with calcium stearate ...	10%	0.07	2.8
,, ,,	20%	0.06	3.5
,, ,,	30%	0.40	3.9
crystalline calcite, particle size predominantly 5 μ, coated with calcium stearate	20%	0.04	2.9
natural, dryly ground and selected calcium carbonate prepared from a very pure calcite having a rhomboedral structure, coated with calcium stearate	20%	0.02	3.1
prepared chalk, not coated with calcium stearate	20%	0.02	2.6
crystalline calcite, particle size predominantly 5 μ, not coated with calcium stearate	2%	0.11	2.0
,, ,,	5%	0.07	2.2
,, ,,	8%	0.06	2.1
comparative unfilled acetal copolymer	—	1.00	2.5

WHAT WE CLAIM IS:—

1. A mixture for the manufacture of a bearing, an element thereof or a body having a sliding surface, which mixture comprises a polyacetal (as hereinbefore defined) having a melt index (i_2) at 190°C within the range of 0.5 gram to 20 grams per 10 minutes and present in an amount within the range of 70 parts to 99.5 parts by weight and a calcite in an amount within the range of 0.5 part to 30 parts by weight.

2. A mixture as claimed in claim 1, wherein the melt index (i_2) of the polyacetal lies within the range of 1 gram to 10 grams per 10 minutes.

3. A mixture as claimed in claim 1 or claim 2, wherein the amount of polyacetal present lies within the range of 80 parts to 99 parts by weight.

4. A mixture as claimed in any one of claims 1 to 3, wherein the amount of the calcite present lies within the range of 1 part to 20 parts by weight.

5. A mixture as claimed in any one of claims 1 to 4 wherein the polyacetal is a homopolymer of formaldehyde or trioxan.

6. A mixture as claimed in any one of claims 1 to 4, wherein the polyacetal is a copolymer of trioxan containing units derived from a cyclic formal or a cyclic ether in an amount of not more than 15% by weight.

7. A mixture as claimed in claim 6, wherein the cyclic formal is diethylene glycol formal or butanediol formal.

8. A mixture as claimed in claim 6, wherein the cyclic ether is dioxolane, tetrahydrofuran, oxacyclobutane or ethylene oxide.

9. A mixture as claimed in any one of claims 1 to 8, wherein the calcite is a chalk.

10. A mixture as claimed in any one of claims 1 to 8, wherein the calcite used is a calcite specified in the Table in the Example herein.

11. A mixture as claimed in any one of claims 1 to 10, containing a stabilizer, a dyestuff, a pigment or a processing auxiliary.

12. A mixture as claimed in claim 11, wherein the stabilizer used is 2,2'-methylene-bis-(4-methyl-6-tertiary-butyl-phenol).

13. A mixture as claimed in claim 11 or claim 12, wherein dicyano-diamide is used as stabilizer.

14. A mixture as claimed in claim 1, having any one of the compositions specified in the Example herein.

15. A process for the manufacture of a bearing, an element thereof or a body having a sliding surface, wherein the article is manufactured from a mixture claimed in any one of claims 1 to 13.

16. A process as claimed in claim 15, wherein the mixture is shaped by press-moulding or extrusion.

17. A process as claimed in claim 15, wherein the mixture is shaped by injection moulding.

18. A bearing, an element thereof, or a body having a sliding surface, manufactured according to a process claimed in any one of claims 15 to 17.

19. A bearing shell, a bearing bush or a sliding guide, manufactured according to a process claimed in any one of claims 15 to 17.

ABEL & IMRAY,
Chartered Patent Agents,
Quality House, Quality Court,
Chancery Lane, London, W.C.2.

Reference has been directed in pursuance of Section 9, subsection (1) of the Patents Act, 1949, to patent No. 912,121.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1968.
Published at The Patent Office, 25 Southampton Buildings, London, W.C.2,
from which copies may be obtained.